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Lee et al.

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(54) **DOOR CLOSER PROVIDED WITH UNIT FOR ADDING DOOR-CLOSING FORCE**

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See application file for complete search history.

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(57) **ABSTRACT**

Disclosed is a door closer provided with a unit for adding door-closing force inside a housing. The disclosed door closer comprises a force-adding unit, which is included inside the housing, for adding the door-closing force. The force-adding unit comprises a cam which coaxially rotates with a link shaft inside the housing, and a cam pusher which is elastically compressed so as to come into close contact with the outer circumferential surface of the cam. The outer circumferential surface of the cam comprises an arc surface portion which is separated apart from a rotary axis of the cam at an equal distance, a concave surface portion which is separated apart from the rotary axis of the cam at a distance shorter than that to the arc surface portion, and one pair of protruding corner portions for connecting the arc surface portion and the concave surface portion. When the outer circumferential surface of the cam with which the cam pusher comes into close contact is converted from the arc surface portion to the concave surface portion due to the rotation of the cam, the rotational force of the link shaft is increased due to the elastic pressing force of the cam pusher.

5 Claims, 3 Drawing Sheets

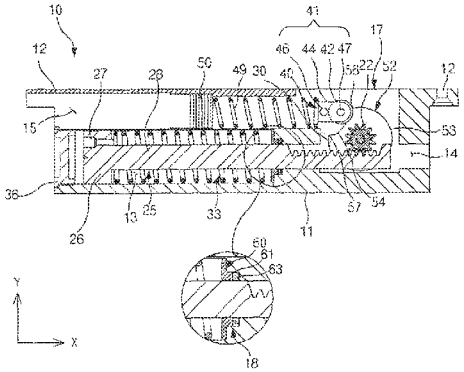

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Fig. 1

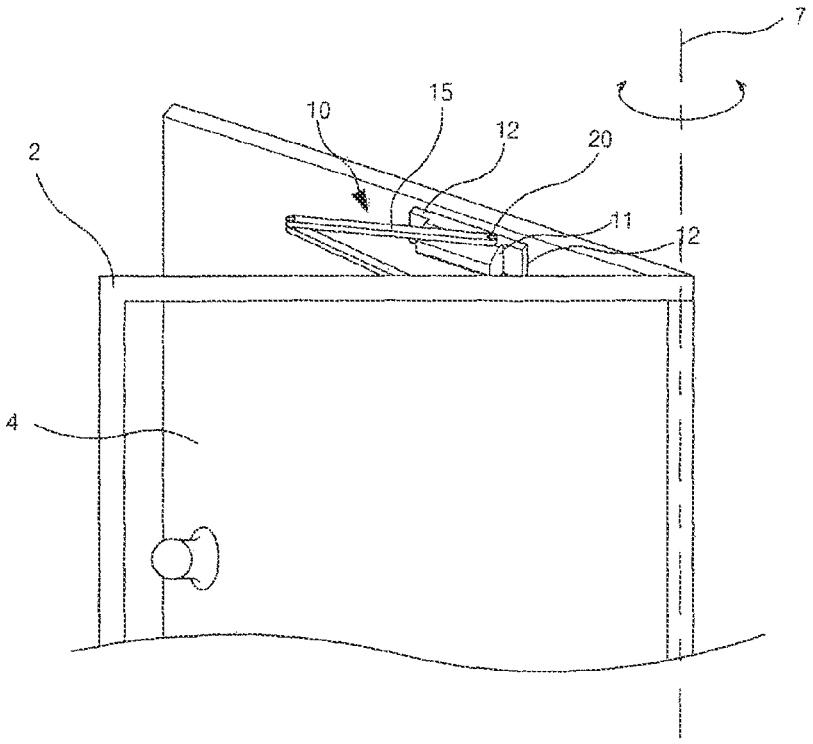
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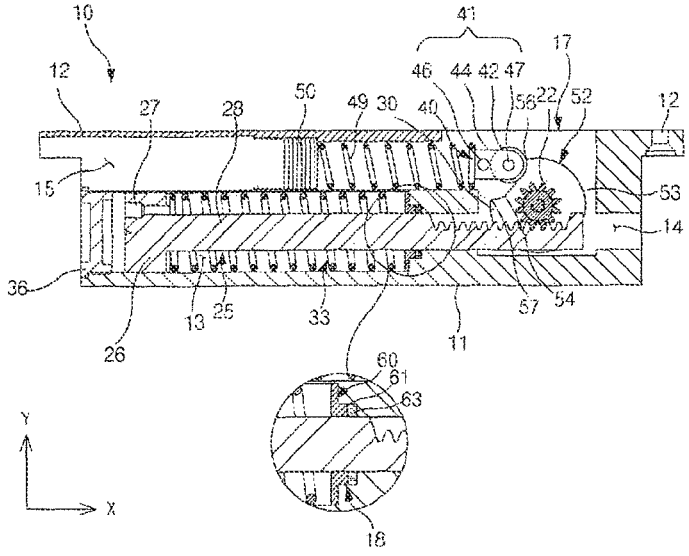
Fig. 2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Y
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18

Fig. 3

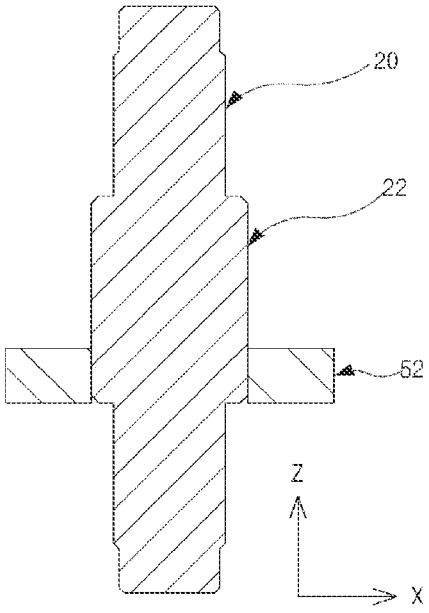
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Fig. 4

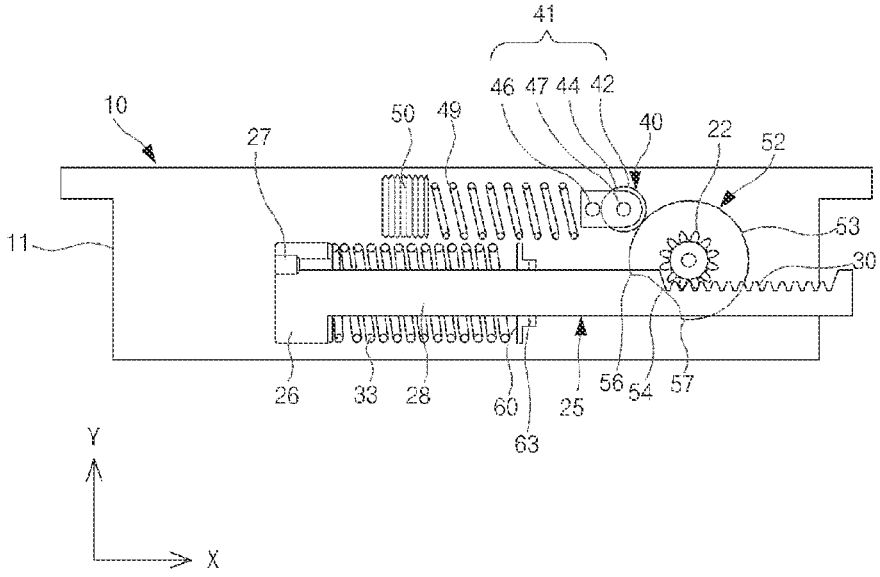
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Fig. 5

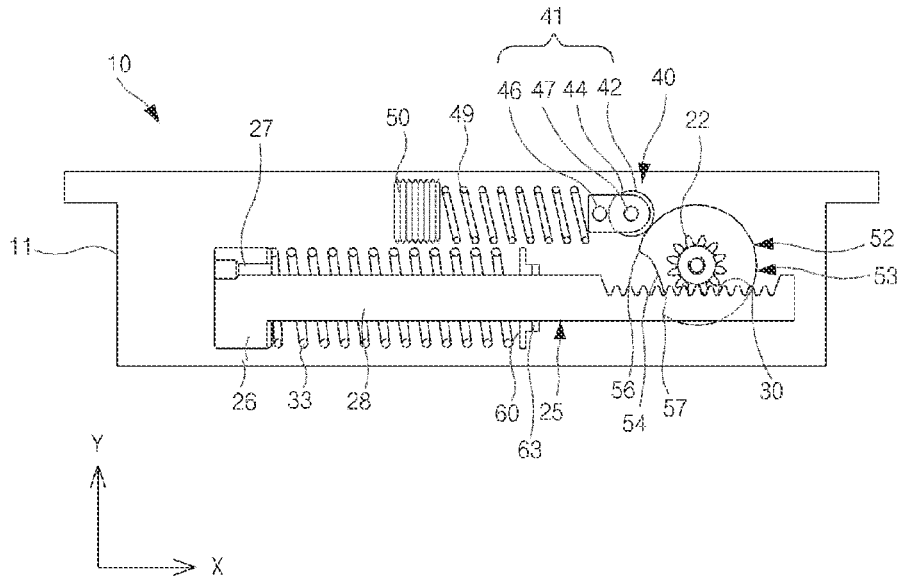
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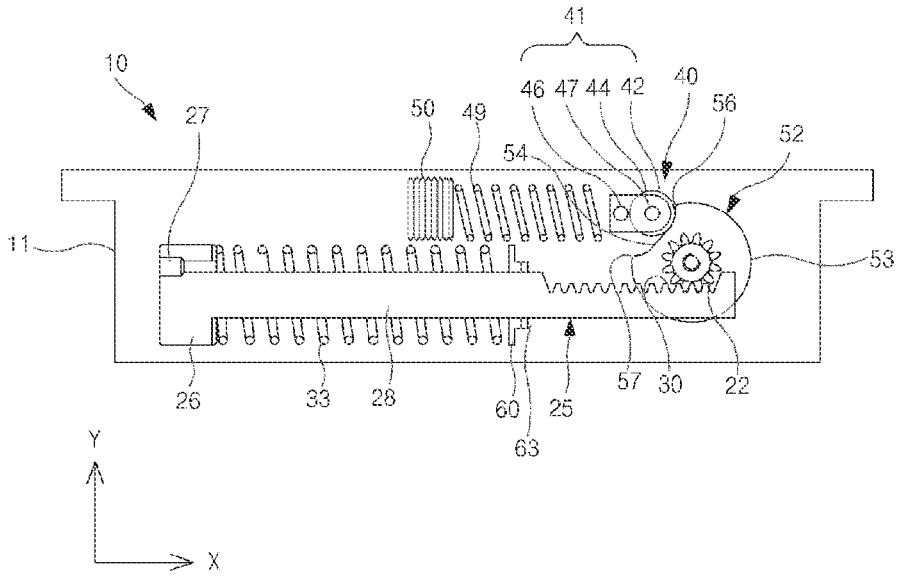
Fig. 6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DOOR CLOSER PROVIDED WITH UNIT FOR ADDING DOOR-CLOSING FORCE

CROSS-REFERENCE TO RELATED APPLICATION

This application is the United States National Stage of and claims priority to International Application No. PCT/KR2013/011061, which was filed Dec. 2, 2013, that claims priority to Korean Application No. 10-2012-0139176 filed Dec. 3, 2012, titled "DOOR CLOSER PROVIDED WITH UNIT FOR ADDING DOOR-CLOSING FORCE", both of which are incorporated herein by reference in their entirety.

TECHNICAL FIELD

The present invention relates to a door closer which automatically closes a hinged door by elastic force when the hinged door is opened.

BACKGROUND ART

A door closer is typically attached to a hinged door such as a front door, fire door, etc. of a house, apartment, officetel, etc. so as to automatically close the door by elastic force when it is opened. In a typical door closer, when the opening angle of the door increases, the expansion of a spring increases, and thus the elastic force increases. Due to the nature of this structure, when the door is almost closed as the door closer operates, the spring is restored to its original length from the state where it is fully expanded, which decreases the elastic force, and thus it is likely that the door is not completely closed.

In order to cope with this problem, door closers provided with a unit for adding door-closing force in a state where the door is almost closed are disclosed in prior art documents such as, for example, Japanese Patent No: 2881552, Korean Patent No: 823143, Korean Patent No: 823854, etc. However, the unit for adding door-closing force is attached to the outside of a housing of the door closer, which increases the size and weight of the door closer and the risk of failure.

DISCLOSURE

Technical Problem

An object of the invention is to provide a door closer which comprises a unit for adding door-closing force that is provided in a housing.

Moreover, another object of the invention is to provide a door closer which can be mounted to a door such that the door can be opened 180° without having to extend the length of a link even when a large spring is mounted to the inside of a housing to increase the elastic force.

Technical Solution

The present invention provides a door closer comprising: a housing which is fixed to a door; a link of which one end is connected to a door frame; a link shaft which is inserted into the housing, of which an upper end projecting to the outside of the housing is connected to the other end of the link, and which is elastically pressurized to rotate in a direction that the door is closed; and a power adding unit which adds power to close the door, the power adding unit comprises a cam which coaxially rotates with the link shaft in the housing and a cam pusher which is elastically pressurized to be in close contact with the outer circumferential surface of the cam, the outer circumferential surface of the cam comprises an arc surface portion which is spaced apart an equal distance from the rotation axis of the cam, a concave surface portion which is spaced apart a distance shorter than the arc surface portion from the rotation axis of the cam, and a pair of projection corner portions which connect the arc surface portion and the concave surface portion, and when the outer circumferential surface of the cam, with which the cam pusher comes into contact, is switched from the arc surface portion to the concave surface portion as the cam rotates, the rotation force of the link shaft is increased by the elastic pressing force of the cam pusher.

The door closer of the present invention may further comprise a pinion gear which coaxially rotates with the link shaft; a piston which extends in the longitudinal direction of the housing, is inserted into the housing to reciprocate in the longitudinal direction of the housing, and comprises a rack gear portion which is formed on one end thereof and engaged with the pinion gear; and a first coil spring which elastically pressurizes the piston such that the link shaft rotates in a direction that closes the door.

The piston may further comprise a piston base portion which is formed on the other end thereof and a piston body portion which connects the piston base portion and the rack gear portion, the first coil spring may be put on the piston body portion and may be compressed and accumulates elastic energy when the link shaft rotates in a direction that closes the door, in which one end of the first coil spring, which is relatively close to the link shaft, may be restricted to move toward the link shaft in the housing and the other end of the first coil spring, which is relatively far from the link shaft, may be pushed by the piston base portion and moves toward the link shaft such that the first coil spring is compressed.

A first spring hole, into which the first coil spring is inserted, a rack gear hole, through which the rack gear portion reciprocates and which has an inner diameter smaller than the inner diameter of the first spring hole and is connected to the first spring hole in a line, and a receiving groove, which has an inner diameter smaller than the inner diameter of the first spring hole and greater than the inner diameter of the rack gear hole, may be formed at the connection between the first spring hole and the rack gear hole in the housing, the door closer may further comprise a damping oil which is filled in the first spring hole and a sealing unit which prevents the damping oil from leaking to the rack gear hole, the sealing unit may comprise a ring-shaped sealing member which is tightly put on the outer circumferential surface of the piston body portion and a washer which has an outer diameter greater than the inner diameter of the rack gear hole, is put on the piston body portion to be located between the sealing member and the coil spring, and is pressurized toward the rack gear hole by the coil spring, and the sealing member may be pressurized toward the rack gear hole by the washer and received in the receiving groove.

The power adding unit may further comprise a second coil spring which elastically pressurizes the cam pusher to be in close contact with the cam and a spring support plug which supports the second coil spring in the housing, and the spring support plug may be configured to adjust the interval between the spring support plug and the cam pusher.

The cam pusher may comprise a rotation member which comes into contact with the outer circumferential surface of the cam and rotates with the rotation of the cam so as to reduce the friction against the cam.

Advantageous Effects

The door closer according to the present invention comprises a unit for adding door-closing force that is provided in

the housing. Therefore, the door closer is smaller in size and lighter in weight. As a result, it is possible to mount the door closer to the door and reduce the risk of failure.

Moreover, even when a large spring is mounted to the inside of the housing to increase the elastic force, the door closer can be attached to the door such that the position of the link shaft is maintained a constant distance from the rotation axis of the door. Thus, the door can be opened 180° without having to extend the length of the link.

Furthermore, when the door closer is mounted to the door, the link shaft which is biased to one side of the housing can be located closer to the rotation axis of the door, thereby increasing the efficiency of the door closer.

DESCRIPTION OF DRAWINGS

FIG. **1** is a perspective view showing a door to which a door closer in accordance with an embodiment of the present invention is mounted.

FIG. **2** is a cross-sectional view showing the inside of a housing of the door closer in FIG. **1**.

FIG. **3** is a longitudinal sectional view showing a link shaft in FIG. **2** and a cam connected thereto.

FIGS. **4** to **6** are cross-sectional views sequentially showing the change of the inside of the housing of the door closer in FIG. **2** while the door is closed.

MODE FOR INVENTION

Hereinafter, a door closer in accordance with an embodiment of the present invention will be described with reference to the accompanying drawings. The terminology used herein is for the purpose of properly describing preferred embodiments only and may be changed according to the intention or usage of a user or operator. Therefore, the terminology should be defined on the basis of the overall contents of this specification.

FIG. **1** is a perspective view showing a door to which a door closer in accordance with an embodiment of the present invention is mounted. Referring to FIG. **1**, a door closer **10** in accordance with an embodiment of the present invention is attached to an upper surface of a hinged door **4** which is opened and closed by rotating with respect to a vertical rotation axis **7**. Specifically, a pair of flanges **12** are fixedly attached to a housing **11** of the door closer **10** by means of screws. One end of a link **15**, to which a pair of sticks are connected, is connected to an upper side of a door frame **2**, and the other end of the link **15** is connected to an upper end of a link shaft **20** which penetrates the housing **11**.

FIG. **2** is a cross-sectional view showing the inside of the housing of the door closer in FIG. **1**, and FIG. **3** is a longitudinal sectional view showing the link shaft in FIG. **2** and a cam connected thereto. Referring to FIGS. **2** and **3**, the door closer **10** in accordance with an embodiment of the present invention comprises a pinion gear **22**, a piston **25**, a first coil spring **33**, and a power adding unit **40**, which are provided in the housing **11**.

The pinion gear **22** is formed on the outer circumferential surface of the link shaft **20** and coaxially rotates with the link shaft **20** with respect to the rotation axis of the link shaft **20** which is in parallel to the Z axis. The piston **25** extends in the longitudinal direction of the housing **11**, i.e. in a direction parallel to the X axis, and is inserted into the housing **11** to reciprocate in the longitudinal direction of the housing **11**. The piston **25** comprises a rack gear portion **30** which is formed on one end thereof and engaged with the pinion gear **22**, a piston base portion **26** which is formed on the other end thereof, and a piston body portion **28** which connects the piston base portion **26** and the rack gear portion **30**.

The first coil spring **33** is a compression spring which accumulates elastic energy upon compression and is put on the piston **25**, specifically, on the piston body portion **28**. When the piston base portion **26** moves towards the link shaft **20**, i.e., when the piston **25** in which the rack gear portion **30** is engaged with the pinion gear **22** moves in the positive (+) direction of the X axis, the first coil spring **33** is compressed and accumulates elastic energy. At this time, the first coil spring **33** elastically pressurizes the piston **25** such that the link shaft **20** rotates in a direction that closes the door **4** (see FIG. **1**).

The link shaft **20** and the pinion gear **22** are located on one side in the longitudinal direction of the housing **11** (in FIG. **2**, the right side of the housing **11**), and the first coil spring **33** and the piston base portion **26** are located on the other side in the longitudinal direction of the housing **11** (in FIG. **2**, the left side of the housing **11**). The first coil spring **33** and the piston **25** can be arranged to overlap each other in the housing **11**, and thus the inside of the housing **11** can be configured compactly and can be reduced in size.

In the housing **11**, a first spring hole **13**, into which the first coil spring **33** is inserted, and a rack gear hole **14**, through which the rack gear portion **30** reciprocates and which has an inner diameter smaller than the inner diameter of the first spring hole **13**, are connected to each other in a line. The first coil spring **33** is inserted into the first spring hole **13**, and then the piston **25** is inserted into the inside of the housing **11** through the first spring hole **13**. The rack gear portion **30** passes through the first spring hole **13** and enters the rack gear hole **14**. One end of the first coil spring **33** has an inner diameter that decreases at the boundary between the first spring hole **13** and the rack gear hole **14**, and thus the movement of the first coil spring **33** in the positive (+) direction of the X axis is restricted. When the piston base portion **26** moves in the positive (+) direction of the X axis, the other end of the first coil spring **33** is pushed by the piston base portion **26** and moves in the same direction. Therefore, when the piston **25** moves in the positive (+) direction of the X axis, the first coil spring **33** is compressed, and when the piston **25** moves in the negative (−) direction of the X axis, the first coil spring **33** is expanded and restored.

According to the door closer **10** of the present invention, even when a large spring **33** is mounted in the housing **11** to increase the door-closing force, the door closer **10** can be attached to the door **4** such that the position of the link shaft **20** (see FIG. **3**) is maintained a constant distance from the rotation axis **7** of the door **4**.

In other words, the link can be fixed in a constant position to face the outside of the door at all times. Therefore, even when the length of the coil spring and the length of the link shaft are extended to increase the elastic force, it is not necessary to further extend the length of the link.

Therefore, it is possible to fully open the door **4** to 180° without having to extend the length of the link **15**. Moreover, when the door closer **10** is mounted to the door **4**, the link shaft **20**, which is biased to one side of the housing **11**, can be located closer to the rotation axis **7** of the door, thereby increasing the efficiency of the door closer **10**.

The door closer **10** comprises a damping oil which is filled in the first spring hole **13** and a sealing unit which prevents the damping oil from leaking to the rack gear hole **14**. The sealing unit comprises a sealing member **63** and a washer **60**. The sealing member **63** is typically made of rubber and has a ring shape that is tightly put on the outer circumferential surface of

the piston body portion **28**. A U-packing having a U-shaped cross section may be used as the sealing member **63**.

The washer **60** is made of metal, has an outer diameter greater than the inner diameter of the rack gear hole **14**, and is put on the piston body portion **28** to be located between the sealing member **63** and the coil spring **33**. The washer **60** is located in the first spring hole **13** and pressurized toward the rack gear hole **14** by the first coil spring **33**. In the housing **11**, a receiving groove **18** having an inner diameter smaller than the inner diameter of the first spring hole **13** and greater than the inner diameter of the rack gear hole **14** is formed at the connection between the first spring hole **13** and the rack gear hole **14**, and the sealing member **63** is pressurized toward the rack gear hole **14** by the washer **60** and received in the receiving groove **18**. The washer **60** comprises an inner circumferential projection **61** which projects so as to push the sealing member **63** to the inside of the receiving groove **18**. Even when the piston **25** moves in the negative (−) direction of the X axis as well as in the positive (+) direction of the X axis, the washer **60** pressurized by the first coil spring **33** pressurizes the sealing member **63** toward the rack gear hole **14**, and thus the sealing member **63** is not separated from the receiving groove **18**, thereby preventing the leakage of the damping oil.

Moreover, an oil passage hole **27** is provided in the piston base portion **26**. When the piston **25** moves in the positive (+) direction of the X axis, i.e., when the door **4** (see FIG. **1**) is opened, the damping oil present at the first coil spring **33** in the first spring hole **13** moves toward a cap **36** through the oil passage hole **27** to delay the movement speed of the piston **25**, thereby reducing the impact due to sudden opening of the door **4**. Meanwhile, when the piston **25** moves in the negative (−) direction of the X axis, i.e., when the door **4** is closed, the damping oil present at the cap **36** in the first spring hole **13** moves toward the first coil spring **33** through the oil passage hole **27** to delay the movement speed of the piston **25**, thereby reducing the impact due to sudden closing of the door **4**.

The power adding unit **40** adds power to close the door when the door (see FIG. **1**) is opened and then closed. The power adding unit **40** comprises a cam **52**, a cam pusher **41**, and a second coil spring **49**. The cam **52** is fixedly connected to the bottom of the pinion gear **22** and coaxially rotates with the rotation axis of the link shaft **20** which is in parallel to the Z axis. The outer circumferential surface of the cam **52** comprises an arc surface portion **53** which is spaced apart an equal distance from the rotation axis of the cam **52**, i.e., the rotation axis of the link shaft **20**, a concave surface portion **54** which is spaced apart a distance shorter than the arc surface portion **53** from the rotation axis of the cam **52**, and a pair of projection corner portions **56** and **57** which connect the arc surface portion **53** and the concave surface portion **54**. A cam insertion groove **17** is provided in the housing **11** such that the cam **52** is installed therein, and the entrance of the cam insertion groove **17** is provided on the side facing the door **4**.

The cam pusher **41** is elastically pressurized to be in close contact with the outer circumferential surface of the cam **52**, and the second coil spring **49** elastically pressurizes the cam pusher **41** toward the cam **52**. The cam pusher **41** comprises a rotation member **42**, a support member **44**, and first and second guide members **46** and **47**. The rotation member **42** comes into contact with the outer circumferential surface of the cam **52** and rotates with the rotation of the cam **52** so as to reduce the friction against the cam **52**. The support member **44** supports the rotation member **42**. The first and second guide members **46** and **47** can move in a direction parallel to the X axis along a guide slot (not shown) formed in the housing **11** and guide the cam pusher **41** to move in a direction parallel to the X axis.

The second coil spring **49** is inserted into a second spring insertion hole **15** which is formed parallel to the first spring hole **13** in the housing **11**. One side of the second coil spring **49** is supported by a spring support plug **50** which is fixed in the middle of the second spring insertion hole, and the other side elastically pressurizes the cam pusher **41**. The spring support plug **50** is configured to adjust the interval between the spring support plug **50** and the cam pusher **41**. Specifically, the spring support plug **50** is screw-connected to the second spring insertion hole **15** and moves in the positive (+) or negative (−) direction of the X axis in response to the rotation direction and amount with respect to the second spring insertion hole **15**, thereby adjusting the interval between the spring support plug **50** and the cam pusher **41**. Therefore, it is possible to adjust the magnitude of the door-closing force added by the power adding unit **40** by adjusting the magnitude of the elastic force of the second coil spring **49**.

The link shaft **20** is biased to one side of the housing **11** in the longitudinal direction of the housing **11** (in FIG. **2**, to the right side), and the second coil spring **49** is located on the other side of the housing **11** in the longitudinal direction of the housing **11** (in FIG. **2** on the left side of the link shaft **20**) apart from the link shaft **20**. Both the first coil spring **33** and the second coil spring **49** are disposed on the left side of the link shaft **20** (see FIG. **2**), and thus the inside of the housing **11** can be configured compactly.

FIGS. **4** to **6** are cross-sectional views sequentially showing the change of the inside of the housing of the door closer in FIG. **2** while the door is closed, and the door closing operation by the door closer **10** will be described below by sequentially referring to FIGS. **2** and **4** to **6**. First, the door **4** (see FIG. **1**) is closed in FIG. **2**, and when the door **4** is opened, the pinion gear **22** formed in the link shaft **20** (see FIG. **3**) rotates in the counterclockwise direction, and as shown in FIG. **4**, the piston **25** moves in the positive (+) direction of the X axis to the maximum. Referring to FIG. **4**, the first coil spring **33** is compressed to its maximum, and as the cam **52** rotates in the counterclockwise direction, the cam pusher **41** comes into contact with the concave surface portion **54** of the cam **52** and then with the arc surface portion **53**, and thus the second coil spring **49** is also compressed.

Referring to FIGS. **4** and **5**, when the power to open the door **4** (see FIG. **1**) is cancelled, the first coil spring **33** expands and elastically pressurizes the piston base portion **26** in the negative (−) direction of the X axis such that the piston **25** moves in the negative (−) direction of the X axis. Accordingly, the pinion gear **22** and the link shaft **20** rotate in the clockwise direction that the door **4** is closed. From the state of FIG. **4** to the state of FIG. **5**, despite the rotation of the cam **52** in the clockwise direction rotation, the cam pusher **41** is brought into contact with the arc surface portion **53**, and thus the second coil spring **49** is not further compressed or expanded.

Referring to FIGS. **5** and **6**, when the door **4** (see FIG. **1**) is almost closed, the elastic restoration force of the first coil spring **33** is reduced to less than the time of FIG. **4**, and thus the door-closing force is reduced. However, due to the rotation of the cam **52** in the clockwise direction, the cam pusher **41** sequentially comes into contact with the arc surface portion **53**, the first projection corner portion **56**, and the concave surface portion **54**. When the outer circumferential surface of the cam **52**, with which the cam pusher **41** comes into contact, is switched from the arc surface portion **53** to the concave surface portion **54**, the second coil spring **49** expands, and the rotation force in the clockwise direction of the link shaft **20** (see FIG. **3**) coaxially connected to the cam **52** is increased by the elastic pressing force of the cam pusher **41**. As a result, the

door **4** is completely closed, and thus it is possible to prevent the introduction of foreign substances, gas, etc., through the door **4** slightly opened.

The invention has been described in detail with reference to preferred embodiments thereof. However, it will be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles and spirit of the invention, the scope of which is defined in the appended claims and their equivalents.

INDUSTRIAL APPLICABILITY

The door closer of the present invention can be applied to various hinged doors of a house, apartment, officetel, etc.

The invention claimed is:

1. A door closer comprising:

a housing which is fixed to a door;

a link of which one end is connected to a door frame;

a link shaft which is inserted into the housing, of which an upper end projecting to the outside of the housing is connected to the other end of the link, and which is elastically pressurized to rotate in a direction that the door is closed; and

a power adding unit which adds power to close the door,

wherein the power adding unit comprises a cam which coaxially rotates with the link shaft in the housing and a cam pusher which is elastically pressurized to be in close contact with the outer circumferential surface of the cam,

wherein the outer circumferential surface of the cam comprises an arc surface portion which is spaced apart an equal distance from the rotation axis of the cam, a concave surface portion which is spaced apart a distance shorter than the arc surface portion from the rotation axis of the cam, and a pair of projection corner portions which connect the arc surface portion and the concave surface portion,

wherein when the outer circumferential surface of the cam, with which the cam pusher comes into contact, is switched from the arc surface portion to the concave surface portion as the cam rotates, the rotation force of the link shaft is increased by the elastic pressing force of the cam pusher, and

wherein the door closer further comprises:

a pinion gear which coaxially rotates with the link shaft;

a piston which extends in the longitudinal direction of the housing, is inserted into the housing to reciprocate in the longitudinal direction of the housing, and comprises a rack gear portion which is formed on one end thereof and engaged with the pinion gear; and

a first coil spring which elastically pressurizes the piston such that the link shaft rotates in a direction that closes the door.

2. The door closer of claim **1**, wherein the piston further comprises a piston base portion which is formed on the other end thereof and a piston body portion which connects the piston base portion and the rack gear portion,

wherein the first coil spring is put on the piston body portion and is compressed and accumulates elastic energy when the link shaft rotates in a direction that opens the door, and

wherein one end of the first coil spring, which is relatively close to the link shaft, is restricted to move toward the link shaft in the housing and the other end of the first coil spring, which is relatively far from the link shaft, is pushed by the piston base portion and moves toward the link shaft such that the first coil spring is compressed.

3. The door closer of claim **2**, wherein a first spring hole, into which the first coil spring is inserted, a rack gear hole, through which the rack gear portion reciprocates and which has an inner diameter smaller than the inner diameter of the first spring hole and is connected to the first spring hole in a line, and a receiving groove, which has an inner diameter smaller than the inner diameter of the first spring hole and greater than the inner diameter of the rack gear hole, is formed at the connection between the first spring hole and the rack gear hole in the housing,

wherein the door closer further comprises a damping oil which is filled in the first spring hole and a sealing unit which prevents the damping oil from leaking to the rack gear hole,

wherein the sealing unit comprises a ring-shaped sealing member which is tightly put on the outer circumferential surface of the piston body portion and a washer which has an outer diameter greater than the inner diameter of the rack gear hole, is put on the piston body portion to be located between the sealing member and the coil spring, and is pressurized toward the rack gear hole by the coil spring, and

wherein the sealing member is pressurized toward the rack gear hole by the washer and received in the receiving groove.

4. The door closer of claim **1**, wherein the power adding unit further comprises a second coil spring which elastically pressurizes the cam pusher to be in close contact with the cam and a spring support plug which supports the second coil spring in the housing, and wherein the spring support plug is configured to adjust the interval between the spring support plug and the cam pusher.

5. The door closer of claim **1**, wherein the cam pusher comprises a rotation member which comes into contact with the outer circumferential surface of the cam and rotates with the rotation of the cam so as to reduce the friction against the cam.

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